



Food and Drug Administration  
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September 2, 2015

Stryker Craniomaxillofacial  
Mr. Nathan Van Sweden  
Senior Manager, Regulatory Affairs  
750 Trade Centre Way, Suite 200  
Portage, Michigan 49002

Re: K143661  
Trade/Device Name: DirectInject®  
Regulation Number: 21 CFR 882.5300  
Regulation Name: Methyl Methacrylate for Cranioplasty  
Regulatory Class: Class II  
Product Code: GXP  
Dated: July 31, 2015  
Received: August 3, 2015

Dear Mr. Van Sweden,

We have reviewed your Section 510(k) premarket notification of intent to market the device referenced above and have determined the device is substantially equivalent (for the indications for use stated in the enclosure) to legally marketed predicate devices marketed in interstate commerce prior to May 28, 1976, the enactment date of the Medical Device Amendments, or to devices that have been reclassified in accordance with the provisions of the Federal Food, Drug, and Cosmetic Act (Act) that do not require approval of a premarket approval application (PMA). You may, therefore, market the device, subject to the general controls provisions of the Act. The general controls provisions of the Act include requirements for annual registration, listing of devices, good manufacturing practice, labeling, and prohibitions against misbranding and adulteration. Please note: CDRH does not evaluate information related to contract liability warranties. We remind you; however, that device labeling must be truthful and not misleading.

If your device is classified (see above) into either class II (Special Controls) or class III (PMA), it may be subject to additional controls. Existing major regulations affecting your device can be found in the Code of Federal Regulations, Title 21, Parts 800 to 898. In addition, FDA may publish further announcements concerning your device in the Federal Register.

Please be advised that FDA's issuance of a substantial equivalence determination does not mean that FDA has made a determination that your device complies with other requirements of the Act or any Federal statutes and regulations administered by other Federal agencies. You must comply with all the Act's requirements, including, but not limited to: registration and listing (21 CFR Part 807); labeling (21 CFR Part 801); medical device reporting (reporting of medical device-related adverse events) (21 CFR 803); good manufacturing practice requirements as set forth in

the quality systems (QS) regulation (21 CFR Part 820); and if applicable, the electronic product radiation control provisions (Sections 531-542 of the Act); 21 CFR 1000-1050.

If you desire specific advice for your device on our labeling regulation (21 CFR Part 801), please contact the Division of Industry and Consumer Education at its toll-free number (800) 638-2041 or (301) 796-7100 or at its Internet address

<http://www.fda.gov/MedicalDevices/ResourcesforYou/Industry/default.htm>. Also, please note the regulation entitled, "Misbranding by reference to premarket notification" (21 CFR Part 807.97). For questions regarding the reporting of adverse events under the MDR regulation (21 CFR Part 803), please go to

<http://www.fda.gov/MedicalDevices/Safety/ReportaProblem/default.htm> for the CDRH's Office of Surveillance and Biometrics/Division of Postmarket Surveillance.

You may obtain other general information on your responsibilities under the Act from the Division of Industry and Consumer Education at its toll-free number (800) 638-2041 or (301) 796-7100 or at its Internet address

<http://www.fda.gov/MedicalDevices/ResourcesforYou/Industry/default.htm>.

Sincerely yours,

**Michael J. Hoffmann -S**

for Carlos L. Peña, PhD, MS  
Director  
Division of Neurological  
and Physical Medicine Devices  
Office of Device Evaluation  
Center for Devices and Radiological Health

Enclosure

## Indications for Use

510(k) Number (if known)

K143661

Device Name

DirectInject

### Indications for Use (Describe)

DirectInject is a self-setting, calcium phosphate cement intended to repair neurosurgical burr holes, contiguous craniotomy cuts and other cranial defects not intrinsic to the stability of the bony structure. It is also intended for augmentation or restoration of bony contour in the craniofacial skeleton to include the cranial and zygomatic bones. DirectInject is intended to repair cranial defects with a surface area of 4 cm<sup>2</sup> or less.

DirectInject is indicated for patients in whom skeletal growth is complete. It can be used in patients with surgically created bone defects.

Type of Use (Select one or both, as applicable)

☒ Prescription Use (Part 21 CFR 801 Subpart D)

☐ Over-The-Counter Use (21 CFR 801 Subpart C)

### CONTINUE ON A SEPARATE PAGE IF NEEDED.

This section applies only to requirements of the Paperwork Reduction Act of 1995.

#### **\*DO NOT SEND YOUR COMPLETED FORM TO THE PRA STAFF EMAIL ADDRESS BELOW.\***

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## 510(k) Summary

This section provides a summary of 510(k) safety and effectiveness information in accordance with the requirements of 21 CFR 807.92.

### I. SUBMITTER

510(k) Owner: Stryker Leibinger GmbH & Co. KG  
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Submitter/ Contact Person: Nathan Van Sweden  
Stryker Craniomaxillofacial  
750 Trade Centre Way  
Portage, MI 49002  
Phone: 269-389-3419  
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Date prepared: August 31, 2015

### II. DEVICE

Trade Name: DirectInject®

Common or Usual name: Methyl methacrylate for cranioplasty

Classification name: Methyl methacrylate for cranioplasty (882.5300)

Regulatory Class: Class II

Product Code: GXP

### III. PREDICATE DEVICE

Primary Predicate: Stryker Injectable Cement – K060763  
This predicate has not been subject to a design-related recall.

Secondary Predicate: BoneSource HAC – K021440  
This predicate has not been subject to a design-related recall.

#### IV. DEVICE DESCRIPTION

Stryker DirectInject consists of a sterile dual paste system, provided pre-filled in a double barrel delivery syringe system, which is calcium phosphate based. Upon injection through the Mixer-Cannula, the two pastes form a cement paste which is injectable, moldable and biocompatible. The injected cement paste will harden under normal body conditions to form hydroxyapatite, which is the principle mineral constituent of bone. The contents are supplied sterile for single patient use in sizes of 3 cc, 5 cc, and 10 cc.

#### V. INTENDED USE/INDICATIONS FOR USE

DirectInject is a self-setting, calcium phosphate cement intended to repair neurosurgical burr holes, contiguous craniotomy cuts and other cranial defects not intrinsic to the stability of the bony structure. It is also intended for augmentation or restoration of bony contour in the craniofacial skeleton to include the cranial and zygomatic bones. DirectInject is intended to repair cranial defects with a surface area of 4 cm<sup>2</sup> or less.

DirectInject is indicated for patients in whom skeletal growth is complete. It can be used in patients with surgically created bone defects.

**TABLE 5-1: COMPARISON OF INDICATIONS FOR USE**

	<b>Subject Device</b>	<b>Primary Predicate – K060763</b>	<b>Secondary Predicate – K021440</b>
<b>Intended Use/Indications for Use</b>	DirectInject is a self-setting, calcium phosphate cement intended to repair neurosurgical burr holes, contiguous craniotomy cuts and other cranial defects not intrinsic to the stability of the bony structure. It is also intended for augmentation or restoration of bony contour in the	Stryker <sup>®</sup> Injectable Cement is a self-setting calcium phosphate cement indicated to fill bony voids or gaps of the skeletal system (i.e. extremities, craniofacial, spine, and pelvic).  These defects may be surgically created or osseous defects created from traumatic injury to the bone. The Stryker Injectable Cement is indicated only for bony voids or gaps that are	BoneSource <sup>®</sup> is a self-setting, calcium phosphate cement intended for use in the repair of neurosurgical burr holes, contiguous craniotomy cuts and other cranial defects as well as in the augmentation or restoration of bony contour in the craniofacial skeleton

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	<p>craniofacial skeleton to include the cranial and zygomatic bones.</p> <p>DirectInject is intended to repair cranial defects with a surface area of 4 cm<sup>2</sup> or less.</p> <p>DirectInject is indicated for patients in whom skeletal growth is complete. It can be used in patients with surgically created bone defects.</p>	<p>not intrinsic to the stability of the bony structure.</p> <p>Stryker® Injectable Cement cured in situ provides an open void/gap filler that can augment provisional hardware (e.g., K-Wires, plates, screws) to help support bone fragments during the surgical procedure. The cured cement acts only as a temporary support media and is not intended to provide structural support during the healing process.</p> <p>Stryker® Injectable Cement is a self-setting, calcium phosphate cement intended for use in the repair of neurosurgical burr holes, contiguous craniotomy cuts and other cranial defects as well as in the augmentation or restoration of bony contour in the craniofacial skeleton.</p>	
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The Indications for Use statement for the Subject device is not identical to the Primary predicate device Stryker Injectable Cement; however, the differences do not alter the intended therapeutic use of the device nor do they affect the safety and effectiveness of the device relative to the predicate. Both devices have the same intended use. The Primary

predicate is indicated for a wider anatomical range of the skeletal system (i.e. extremities, craniofacial, spine, and pelvic). The Indications for use of the Stryker DirectInject falls within the scope of the broader Indications for Use statement of the Primary predicate device.

The Indications for Use statement for the Subject device is not identical to the Secondary predicate device Bonesource HAC; however, the differences do not alter the intended therapeutic use of the device nor do they affect the safety and effectiveness of the device relative to the predicate. Both devices have the same intended use.

## VI. COMPARISON OF TECHNOLOGICAL CHARACTERISTICS WITH THE PREDICATE DEVICE

The Stryker DirectInject is compared to its predicate devices for substantial equivalence based on the following criteria:

- A. Principle of Operation
- B. Technological Characteristics

### **A. Principle of Operation**

The operating principle of the Stryker DirectInject is to repair neurosurgical burr holes, contiguous craniotomy cuts and other cranial defects. It is also intended for the augmentation or restoration of bony contour in the craniofacial skeleton. The Subject device and Predicate devices have the same principle of operation.

### **B. Technological and Operational Characteristics**

At a high level, the Subject device and Predicate devices are based on the following technological elements:

- Same operating principle: repair neurosurgical burr holes, contiguous craniotomy cuts and other cranial defects.
- Same area of application: Craniofacial (Cranial and Zygomatic Bones)
- Same duration of implantation: implant is osteointegrated via normal bone physiological conditions.
- Similar control mechanism: The Subject device uses a dual syringe with pastes and a Mixer-Cannula, while the predicate devices use powder and liquid bases, a mixing apparatus and syringe (primary predicate).
- Similar material formulation: Both the Primary and Secondary predicates and the Subject device form Hydroxyapatite cement, however, due to the paste form of the Subject device, a proprietary material formulation is used.

## VII. PERFORMANCE DATA

The following performance data are provided in support of the substantial equivalence determination.

### **Biocompatibility Testing**

The biocompatibility evaluation for the Stryker DirectInject was conducted in accordance with

- The FDA Blue Book Memorandum #G95-1 “*Use of International Standard ISO-10993, ‘Biological Evaluation of Medical Devices Part 1: Evaluation and Testing,’*” May 1, 1995,
- ISO 10993-1 “*Biological Evaluation of Medical Devices – Part 1: Evaluation and Testing Within a Risk Management Process,*” as recognized by FDA.
- FDA draft guidance “*Use of International Standard ISO- 10993, “Biological Evaluation of Medical Devices Part 1: Evaluation and Testing,”* issued April 23, 2013

Stryker DirectInject is considered a permanent implant, tissue/bone contacting greater than 30 days. The implant is Hydroxyapatite cement, the same as the Predicate devices.

**TABLE 5-2 BIOCOMPATIBILITY TESTING FOR STRYKER DIRECTINJECT**

<b>Test</b>	<b>Standard</b>
Cytotoxicity	ISO-10993-5
Irritation	ISO-10993-10 & ISO-10993-2
Sensitization	ISO-10993-10 & ISO-10993-2
Acute systemic toxicity	ISO-10993-11 & ISO-10993-2
Genotoxicity: Bacterial reverse mutation	ISO-10993-3
Genotoxicity: Mouse lymphoma Assay	ISO-10993-3
Genotoxicity: Mouse peripheral blood micronucleus study	ISO-10993-3 & ISO-10993-2

Haemocompatibility	ISO-10993-4 & ASTM F756
Sub-Chronic Toxicity	ISO-10993-11 & ISO-10993-2
Chronic toxicity	ISO-10993-11 & ISO-10993-2
Neurotoxicity (8 weeks)	ISO-10993-6 & ISO-10993-2

### Performance Bench Testing

The following performance bench tests were completed per the requirements of ‘Class II Special Controls Guidance Document: Resorbable Calcium Salt Bone Void Filler Device; Guidance for Industry and FDA’.

**TABLE 5-3 PERFORMANCE TESTING FOR STRYKER DIRECTINJECT**

Characteristic	Test	Standard
Chemical Characterization	X-ray diffraction	International Centre for Diffraction Data (ICDD)
	Fourier Transform Infrared Spectroscopy	N/A
	X-ray Fluorescence	N/A
Physical Properties	Porosity	ASTM D4404-10, ASTM D4284-12
Performance	pH testing	USP <791>
	Setting time	N/A
	Dimensional stability	N/A
	Setting reaction temperature	N/A
	Injectability force	N/A

In addition to the test methods identified above, the following tests were performed to address risk identified or design requirements.

**TABLE 5-4 PERFORMANCE TESTING FOR STRYKER DIRECTINJECT**

Characteristic	Test	Standard
Performance	Compressive Strength	N/A
	Max supported defect strength	N/A
	Shelf life Assessment	ICH Q1A(R2)

**In-Vivo Testing**

The following local effects in-vivo tests were performed as per the requirements of ISO-10993-2 and ISO-10993-6. The in-vivo local effects of Stryker DirectInject were evaluated in a sheep and rabbit model, by macroscopic and histological evaluation of the tissue in the treatment areas. These studies demonstrated that Stryker DirectInject is stable, osteoconductive, and integrates with the bone tissue surrounding the defect site.

**Clinical Testing**

Clinical testing was not required as a basis for substantial equivalence.

**VIII. CONCLUSIONS**

The results of the non-clinical data demonstrate the Stryker DirectInject will perform as intended in the specified use conditions. According to the comparison based on the requirements of 21 CFR 807.87 and the information provided herein, it is concluded that the information included in this submission supports substantial equivalence.